Chapter 14 Review Key

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \quad PV = nRT \quad R = 0.821\ \frac{L \cdot atm}{K \cdot mol} \quad R = 8.31\ \frac{L \cdot kPa}{K \cdot mol} \quad R = 62.4\ \frac{L \cdot mmHg}{K \cdot mol}$$

1atm = 101.3kPa = 760 mmHg = 14.7psi

Gas Variables

What is the relationship between the pressure and volume of a gas? Direct or Indirect

If the volume of a container of gas is reduced by half, how does the pressure change?

increases by 2

What is the relationship between pressure and temperature? Direct or Indirect

If the temperature of a gas is increased, why does the pressure increase as well?

Heating the gas gives the gas particles more kinetic energy. With more energy the make more collisions w/ the container and eachother.

What is the relationship between volume and temperature? Direct or indirect

If a balloon containing a 2L of a gas were cooled to one half of its original temperature, to what degree would its volume change?

It would be reduced by 1/2 = 1L

Rearrange the combined gas law to solve for P_1 and the ideal gas law to solve for P.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad P_1 = \frac{P_2V_2T_1}{V_1T_2} \qquad PV = nRT \qquad P = \frac{nRT}{V}$$

Rearrange the combined gas law to solve for T_1 and the ideal gas law to solve for T.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \qquad T_1 = \frac{P_1V_1T_2}{P_2V_2}$$

Problems

It is hard to begin inflating a balloon. A pressure of 800.0 Kpa is required to initially inflate the balloon 225.0 mL. What is the final pressure when the balloon has reached it's capacity of 1.2 L?

$$P_1V_1 = P_2V_2 \qquad P_2 = \frac{P_1V_1}{V_2}$$

P_1 = 800 KPa

V_1 = 225.0 mL = 0.225L

P_2 = x

V_2 = 1.2 L

$$\frac{(800\ KPa)(0.225L)}{1.2L} = \boxed{150\ KPa}$$

If I have 45 liters of helium in a balloon at 25^0 C and increase the temperature of the balloon to 55^0 C, what will the new volume of the balloon be?

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$ $V_2 = \frac{V_1 T_2}{T_1}$

$V_1 = 45\ L$

$T_1 = 25 + 273 = 298K$

$V_2 = X$

$T_2 = 55 + 273 = 328K$

$\frac{(45L)(328K)}{298K} = \boxed{49.5\ L}$

If a gas is cooled from 323.0 K to 273.15 K and the volume is kept constant what final pressure (in kPa) would result if the original pressure was 750.0 mm Hg?

$P_1 : 323K$

$T_1 : 750mmHg \left(\frac{101.3}{760}\right) = 100kPa$

$P_2 = X$

$T_2 = 273.15\ K$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $P_2 = \frac{P_1 T_2}{T_1}$

~~750mmHg~~

$\frac{(100kPa)(273.15K)}{323} = \boxed{84.6\ kPa}$

A gas that has a volume of 28 liters, a temperature of 45 °C, and an unknown pressure has its volume increased to 34 liters and its temperature decreased to 35 °C. If I measure the pressure after the change to be 2.0 atm, what was the original pressure of the gas?

$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$

$P_1\ X$

$V_1 = 28L$

$T_1 = 45 + 273 = 318$

$P_2 = 2atm$

$V_2 = 34$

$T_2 = 35 + 273 = 308$

$P_1 = \frac{P_2 V_2 T_1}{T_2 V_1}$

$\frac{(2atm)(34L)(318K)}{(308K)(28L)} = \boxed{2.5 atm}$

If I have 7.7 moles of gas at a pressure of 0.09 atm and at a temperature of 56 °C, what is the volume of the container that the gas is in?

$PV = nRT$ $V = \frac{nRT}{P}$

$\frac{(7.7moles)\left(0.0821\frac{L \cdot atm}{K \cdot mol}\right)(329K)}{0.09atm} = \boxed{2311\ L}$

How many liters of water vapor can be made from 55 grams of oxygen gas and an excess of hydrogen at STP?

$2H_2 + O_2 \rightarrow 2H_2O_g$

$55g\ O_2 \left(\frac{1mol\ O_2}{32g}\right)\left(\frac{2mol\ H_2O}{1mol\ O_2}\right)\left(\frac{22.4L}{1mol}\right) = \boxed{77L}$

If 13.5 g of aluminum is reacted with excess hydrochloric acid in a 2.0 L bottle at 26°C, what would the pressure be given the following equation: $2Al(s) + 6\ HCl\ (aq) \rightarrow 2AlCl_3\ (aq) + 3\ H_2\ (g)$

$13.5g\ Al \left(\frac{1mol\ Al}{27g}\right)\left(\frac{3mol\ H_2}{2mol\ Al}\right) = 0.75mol\ H_2$

$PV = nRT$

$P = \frac{nRT}{V}$

$\frac{(0.75)\left(0.0821\frac{L \cdot atm}{K\ mol}\right)(299)}{2}$

$\boxed{9.2atm}$